



DEPARTMENT OF TRANSPORTATION  
UNITED STATES COAST GUARD

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NVC 3-77

22 AUG 1977

NAVIGATION AND VESSEL INSPECTION CIRCULAR NO.3-77

Subj: Code of Safe Practice for Ships Carrying Timber Deck Cargoes

1. Purpose: Enclosure (1), "Code of Safe Practice for Ships Carrying Timber Deck Cargoes" was adopted by the Intergovernmental Maritime Consultative Organization on 20 November 1973 and is issued as information and guidance to naval architects, ship operators, marine surveyors, and others involved in the design or operation of vessels carrying timber deck cargoes.

2. Discussion. Enclosure (1) does not in any way supersede the requirements contained in 46 CFR 42.25, Special Requirements for Vessels Assigned Timber Freeboards or in 46 CFR 93, Stability for Cargo and Miscellaneous Vessels. Enclosure (1) primarily contains guidance material and the Coast Guard does not intend to implement this Code into regulations. It should be noted, that this Code may apply to U.S. vessels loading timber deck cargo in ports of countries which have adopted the Code into their national regulations.

  
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Encl:

(1) Code of Safe Practice for Ships  
Carrying Timber Deck Cargoes

DIST: (SDL No. 105)

A: None

B: n(45); c(10); q(6); eg(3); bjp(1)

C: em(4); o(2)

D: ij(2); l(1)

E: o(2); mn(1)

F: None

List CG-12



IMCO

RESOLUTION A.287(VIII)

adopted on 20 November 1973

CODE OF SAFE PRACTICE FOR  
SHIPS CARRYING TIMBER DECK CARGOES

Encl (1) NVC 3-77

22 AUG 1977

Distr.  
GENERAL

A VIII/Res.287  
21 December 1973

Original: ENGLISH

THE ASSEMBLY,

NOTING Article 16(i) of the Convention on the Inter-Governmental Maritime Consultative Organization concerning the functions of the Assembly,

BEARING IN MIND Chapter IV of the International Convention on Load Lines, 1966 and Resolutions A.167(ES.IV) and A.206(VII) concerning intact stability for passenger and cargo ships under 100 metres in length,

HAVING CONSIDERED the Code of Safe Practice for Ships Carrying Timber Deck Cargoes and the relevant Recommendation of the Maritime Safety Committee included in the Report on its twenty-fifth session, considered by Council at its twenty-eighth session and transmitted to the Assembly,

RESOLVES:

- (a) to adopt the Code of Safe Practice for Ships Carrying Timber Deck Cargoes, the text of which appears at Annex to this Resolution;
- (b) to recommend that governments implement the Code;
- (c) to authorize the Maritime Safety Committee to keep the Code up to date by considering and adopting such amendments as may be necessary.

REQUESTS the Secretary-General to publish the Code of Safe Practice for Ships Carrying Timber Deck Cargoes together with its Annexes in the four official languages of the Organization for distribution (two copies each) to Member States and to States which participated in the International Conference on Safety of Life at Sea, 1960, and for general sale and to publish revised editions as necessary.

ANNEX

CODE OF SAFE PRACTICE FOR  
SHIPS CARRYING TIMBER DECK CARGOES

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### CODE OF SAFE PRACTICE FOR SHIPS CARRYING TIMBER DECK CARGOES

#### Section 1 – SCOPE

- 1.1 The provisions given hereunder are recommended for all ships of 24 metres (79 feet) or more in length engaged in the carriage of timber deck cargoes.
- 1.2 Administrations are invited to adopt these recommendations unless they are satisfied that operating experience justifies departures therefrom.
- 1.3 Nothing in these recommendations shall preclude the application of Regulation 44 of the 1966 Load Line Convention as far as ships with timber loadlines are concerned or any national requirements.
- 1.4 For the purpose of these recommendations "Timber Deck Cargo" or "Cargo" means a cargo of timber carried on an uncovered part of a freeboard or superstructure deck, which should include logs, sawn timber whether loose or packaged.

#### Section 2 – STOWAGE – GENERAL

- 2.1 Openings in the weather deck on which cargo is stowed should be securely closed and battened down. Ventilators and air pipes should be effectively protected from damage by cargo and the check valves in air pipes should be examined to ascertain that they or similar devices are effective against the entry of sea water.
- 2.2 The cargo should be compactly stowed and should be chocked, as necessary, for this purpose; it should not interfere in any way with the navigation and necessary work of the ship and should be stowed as level as practicable. Safety equipment, devices for remote operation of valves and sounding pipes should be clearly marked and left accessible.
- 2.3 Steering gear components should be efficiently protected from damage and the arrangements made for steering in the event of a breakdown in the main steering gear should not be obstructed by deck cargo.

2.4 Safe and satisfactory access to the crew's quarters, machinery spaces and all other forward and after parts used in the necessary working of the ship should be provided at all times. Cargo in the vicinity of the openings which give access to such parts should be so stowed that the openings can be properly closed and secured against the entry of water.

2.5 Uprights, when required by the nature or height of the timber, should be of adequate strength which should not exceed the strength of the bulwark and the spacing should be suitable for the length and character of timber carried, but should not exceed 3 metres (9.8 feet). Strong angles or metal sockets or equally efficient means should be provided for securing the uprights. Where suitable, permanent ship's structure may be used as uprights.

- 2.5.1 The uprights should be of such height as to extend above the outboard top edge of the cargo.
- 2.5.2 They should preferably be fitted with a locking pin or other arrangement to retain the upright in its housing.
- 2.5.3 They may be secured by a metal bracket attaching the upright to the top of the ship's bulwark, or a similar arrangement.
- 2.5.4 As far as is practicable, the stowage should be such that the cargo throughout its full height is in solid contact with each upright.
- 2.5.5 Each port and starboard pair of uprights should be linked by athwartship lashings, set up taut joining each pair as near to the top level of the cargo as possible to give additional strength to these uprights. The lashings should be in accordance with the recommendations of Section 4.

### Section 3 - LASHINGS - GENERAL

3.1 At the completion of loading, a system of overall independent athwartship lashings to the specification as given in Section 4 should be set up throughout the entire length of a deck stow. The spacing between adjacent lashings should be in accordance with Sub-Sections 5.2 and 5.3 such that each lashing should pass over the cargo and be shackled to eye plates positioned in the sheer strake, deck stringer plate or other strengthened point. Stanchions and brackets or other such points of insufficient strength should not be used for the securing of lashings.

3.2 Stretching devices or similar devices for lashing shall be either a turnbuckle or of a type that produces tightening by a lever action having a proven mechanical arrangement whereby tightening to the required tension and subsequent adjustments can be rapidly effected; each specified device should be so placed in a lashing that it can be safely and efficiently operated when required.

3.3 When such devices are of a portable type, a sufficient number should be carried on board.

3.4 A device capable of quick cargo release, if fitted, should be so designed that it cannot be accidentally released or activated.

3.5 When other devices are substituted for splicing to form an eye in wire rope, they should be sufficient to equal the strength of the splice.

3.6 Lashings should be inspected as required.

### Section 4 - LASHINGS, TESTING AND CERTIFICATION

4.1 All testing, marking, and certification of the chains should conform with national regulations.

4.2 In addition to the requirements stated, a visual examination at intervals not exceeding 12 months is recommended.

4.3 Any lashing used in compliance with these Recommendations should withstand an ultimate load of not less than 13600 kg (30,000 lb).

4.4 After testing there should be no treatment applied to chain which would invalidate its test certificate, e.g. galvanizing heat treatment.

4.5 Shackles, stretching devices and all other ancillary components incorporated into a chain or wire rope lashing and its securings should have a minimum ultimate load of 14100 kg (31,000 lb). Each component should be proof loaded to 5600 kg (12,300 lb). No part should be damaged or permanently deformed after proof loading.

## Section 5 - STOWAGE AND SECURING OF LOOSE OR PACKAGED SAWN TIMBER CARGOES

- 5.1 The timber should be loaded to produce a compact stow with a level surface as far as practicable.
- 5.2 The spacing of the lashing should be determined by the maximum height of the cargo above the weather deck in the vicinity of the lashing:
- (a) for the height of 4 metres (13 feet) and below the spacing should be 3 metres (9.8 feet);
  - (b) for the height of 6 metres (19.6 feet) and above the spacing should be 1.5 metres (4.9 feet);
  - (c) at intermediate heights the average spacing should be obtained by linear interpolation.
- 5.3 When timber is in lengths less than 3.6 metres (11.8 feet) the spacing of the lashings shall be reduced or other suitable provisions made to suit the length of timber.
- 5.4 The spacing should also be such that the first and the final athwartship lashing of each section of continuous deck stow should be positioned as close as is practicable to the extreme end of the stow.

## Section 6 - STOWAGE AND SECURING OF LOG CARGOES, PULP WOOD AND PITPROP CARGOES

- 6.1 Whenever possible logs should be compactly stowed in a fore and aft direction to give a level or crowned top surface such that each log is adequately restrained from movement when the system of securings is in place and set up taut.
- 6.2 Where uprights are required by the height of the stow they should be fitted to conform with the recommendations of Sub-Section 2.5.
- 6.3 The stowage of pulp wood and pitprop cargoes on deck should comply with any locally accepted practice which has been shown to be safe so that, at the completion of stowage, the cargo shall be compact, having a level or crowned surface and be secured at least to meet the provisions of this Code.
- 6.4 When only a part of a total timber deck cargo consists of pulp wood or pitprop logs, the logs should be stowed and secured separately when practicable, but if the nature and quantity of the remainder of the timber deck cargo is such that the pulp wood or pitprop portion can be compactly stowed and contained within the main stowage, and the lashings required by the main stowage will efficiently restrain the pulp wood or pitprops, then such stowage method should be adopted.

## Section 7 - STABILITY

- 7.1 All ships should be supplied with suitable information on stability which takes into account deck cargo to enable the master of the ship to meet national requirements.
- 7.2 Where no national requirements exist, information on stability should be supplied in accordance with paragraph 7 of the Annex to IMCO Assembly Resolution A.167(ES.IV) as amended by Resolution A.206(VII) (see Annex B).
- 7.3 The master should establish or verify the stability of his vessel for the worst service condition having regard to the increased weight of deck cargo due to water absorption and/or ice accretion and to variations in consumables. It should be kept in mind that excessive stability might cause more severe force on the lashings in heavy seas.

## Section 8 - COMPACTING OF DECK STOW IN SHELTERED WATERS

- 8.1 At the completion of loading and securing, all tightening devices fitted into the lashings should, after the initial tightening, be left with not less than half the threaded length of screw, or of tightening capacity, to be available for future tightening.
- 8.2 All vessels should, before leaving sheltered areas, allow time for additional tightening, as necessary, of all lashings by the crew prior to entering the open sea and an entry made in the ship's log-book.

## Section 9 - HEIGHT OF CARGO

- 9.1 On a ship within a seasonal winter zone in winter, the mean height of the cargo above the weather deck should not exceed one-third of the extreme breadth of the ship. For the purpose of this Sub-Section, the "weather deck" means the uppermost complete deck exposed to weather and sea, a deck which is stepped being taken to consist of the lowest line of the deck and the continuation of that line parallel to the upper part of the deck.

9.2 The height of the deck cargo should be so controlled that its weight does not exceed the designed maximum permissible load on weather decks and hatchies.

9.3 Masters should be provided with such information as to comply with Sub-Section 9.2.

9.4 The height of the deck cargo should be restricted so that:

- (i) visibility from the navigation bridge is not impaired;
- (ii) any forward facing profile of the deck stow does not present overhanging shoulders to a head sea.

## Section 10 - PROTECTION OF CREW

10.1 A satisfactory and safe means of access to crew's quarters, and all parts used in the necessary working of the ship should be provided. This may take the form of guard lines or rails on each side of the deck cargo not more than 33 centimetres (13 inches) apart vertically and to a height of at least 1 metre (3.3 feet) above the walking surface. In addition a lifeline, preferably wire rope with a stretching device, set up taut situated as near as practicable to the centreline of the ship, should be provided. The stanchion supports to all guard rails and lifelines should be spaced so as to prevent undue sagging. Where the cargo is uneven a safe walking surface of not less than 60 centimetres (2 feet) width should be fitted over the cargo and effectively secured beneath or adjacent to the lifeline.

10.2 Fencing or closing should be provided for all openings in the stow such as at masts, winches, etc.

10.3 Alternative to the provisions of Sub-Sections 10.1 and 10.2, or where uprights are not fitted, a walkway of substantial construction should be provided having an even walking surface and consisting of two fore and aft sets of guard wires or rails about 1 metre apart, each having a minimum of three courses of wires or rails to a height of not less than 1 metre (3.3 feet) above the walking surface. The lowest course should not exceed 23 centimetres (9 inches) above the walking surface and the other courses should be not more than 38 centimetres (15 inches) apart. Such guard wires or rails should be supported by rigid stanchions spaced not more than 3 metres (9.8 feet) apart and wires should be set up taut by stretching screws.

10.4 Properly constructed ladders or steps fitted with guard wires or handrails should be provided:

- (a) from the top of the cargo to the deck; and
- (b) where the cargo is stepped more than 68 centimetres (27 inches).

## ANNEX A

### TEXT OF REGULATION 44 OF THE INTERNATIONAL CONVENTION ON LOAD LINES, 1966

#### *"Stowage"*

##### *General*

- (1) Openings in the weather deck over which cargo is stowed shall be securely closed and battened down. The ventilators shall be efficiently protected.
- (2) Timber deck cargo shall extend over at least the entire available length which is the total length of the well or wells between superstructures. Where there is no limiting superstructure at the after end, the timber shall extend at least to the after end of the aftermost hatchway. The timber shall be stowed as solidly as possible to at least the standard height of the superstructure.
- (3) On a ship within a seasonal winter zone in winter, the height of the deck cargo above the weather deck shall not exceed one-third of the extreme breadth of the ship.
- (4) The timber deck cargo shall be compactly stowed, lashed and secured. It shall not interfere in any way with the navigation and necessary work of the ship.

*Uprights*

- (5) Uprights, when required by the nature of the timber, shall be of adequate strength considering the breadth of the ship: the spacing shall be suitable for the length and character of timber carried, but shall not exceed 3 metres (9.8 feet). Strong angles or metal sockets or equally efficient means shall be provided for securing the uprights.

*Lashings*

- (6) Timber deck cargo shall be efficiently secured throughout its length by independent overall lashings spaced not more than 3 metres (9.8 feet) apart. Eye plates for these lashings shall be efficiently attached to the sheer strake or to the deck stringer plate at intervals of not more than 3 metres (9.8 feet). The distance from an end bulkhead of a superstructure to the first eye plate shall be not more than 2 metres (6.6 feet). Eye plates and lashings shall be provided 0.6 metre (23½ inches) and 1.5 metres (4.9 feet) from the ends of timber deck cargoes where there is no bulkhead.
- (7) Lashings shall be not less than 19 millimetres (¾ inch) close link chain or flexible wire rope of equivalent strength, fitted with sliphooks and turnbuckles, which shall be accessible at all times. Wire rope lashings shall have a short length of long link chain to permit the length of lashings to be regulated.
- (8) When timber is in lengths less than 3.6 metres (11.8 feet) the spacing of the lashings shall be reduced or other suitable provisions made to suit the length of timber.
- (9) All fittings required for securing the lashings shall be of strength corresponding to the strength of the lashings.

*Stability*

- (10) Provision shall be made for a safe margin of stability at all stages of the voyage, regard being given to additions of weight, such as those due to absorption of water and icing and to losses of weight such as those due to consumption of fuel and stores.

*Protection of Crew, Access to Machinery Spaces, etc.*

- (11) In addition to the requirements of Regulation 25(5) of this Annex guard rails or lifelines spaced not more than 33 centimetres (13 inches) apart vertically shall be provided on each side of the deck cargo to a height of at least 1 metre (39½ inches) above the cargo.

*Steering Arrangements*

- (12) Steering arrangements shall be effectively protected from damage by cargo and, as far as practicable, shall be accessible. Efficient provision shall be made for steering in the event of a breakdown in the main steering arrangements."

ANNEX B

(This Annex and its Appendices I to IV reproduce the text of the Recommendation on Intact Stability for Passenger and Cargo Ships under 100 Metres in Length, adopted by the 4th Extraordinary Session of the IMCO Assembly (Resolution A.167(ES.IV)), as amended with respect to ships carrying deck cargoes by Resolution A.206(VII), adopted by the 7th Ordinary Session of the IMCO Assembly.)

RECOMMENDATION ON INTACT STABILITY FOR  
PASSENGER AND CARGO SHIPS UNDER 100 METRES IN LENGTH  
AS AMENDED WITH RESPECT TO SHIPS  
CARRYING DECK CARGOES

## 1. SCOPE

1.1 The provisions given hereunder are recommended for new decked sea-going passenger and cargo ships (other than fishing vessels\*) under 100 metres in length.

\* A separate recommendation is issued for fishing vessels.

1.2 Administrations are invited to adopt, for all conditions of loading, the stability criteria given in paragraph 5 unless they are satisfied that operating experience justifies departures therefrom.

## 2. GENERAL PRECAUTIONS AGAINST CAPSIZING

2.1 Compliance with the stability criteria does not ensure immunity against capsizing regardless of the circumstances or absolve the master from his responsibilities. Masters should therefore exercise prudence and good seamanship having regard to the season of the year, weather forecasts and the navigational zone and should take the appropriate action as to speed and course warranted by the prevailing circumstances.

2.2 Care should be taken that the cargo allocated to the ship is capable of being stowed so that compliance with the criteria can be achieved. If necessary the amount should be limited to the extent that ballast weight may be required.

2.3 Before a voyage commences care should be taken to ensure that the cargo and sizeable pieces of equipment have been properly stowed or lashed so as to minimize the possibility of both longitudinal and lateral shifting while at sea, under the effect of acceleration caused by rolling and pitching.

## 3. CALCULATION OF STABILITY CURVES

The methods and procedures employed for calculating stability righting arms should be in accordance with Appendix I, and the degree of accuracy obtained should be acceptable to the Administration.

## 4. ASSESSMENT OF COMPLIANCE WITH CRITERIA

4.1 For the purpose of assessing in general whether the criteria are met, stability curves should be drawn for the main loading conditions intended by the owner in respect of the ship's operations.

4.2 If the owner does not supply sufficiently detailed information regarding such loading conditions, calculations should be made for the standard conditions given in Appendix II.

4.3 In all cases calculations should be based on the assumptions shown in Appendix II.

## 5. RECOMMENDED CRITERIA

5.1 The following criteria are recommended for passenger and cargo ships:

- (a) The area under the righting lever curve (GZ curve) should not be less than 0.055 metre-radians up to  $\theta = 30^\circ$  angle of heel and not less than 0.09 metre-radians up to  $\theta = 40^\circ$  or the angle of flooding  $\theta_f^*$  if this angle is less than  $40^\circ$ .

Additionally, the area under the righting lever curve (GZ curve) between the angles of heel of  $30^\circ$  and  $40^\circ$  or between  $30^\circ$  and  $\theta_f$ , if this angle is less than  $40^\circ$ , should not be less than 0.03 metre-radians.

- (b) The righting lever GZ should be at least 0.20 m at an angle of heel equal to or greater than  $30^\circ$ .
- (c) The maximum righting arm should occur at an angle of heel preferably exceeding  $30^\circ$  but not less than  $25^\circ$ .
- (d) The initial metacentric height  $GM_0$  should not be less than 0.15 m.

5.2 For ships loaded with timber deck cargoes and provided that the cargo extends longitudinally between superstructures\*\* transversely for the full beam of ship after due allowance for a rounded gunwale not exceeding 4 per cent of the breadth of the ship and/or securing the supporting uprights and which remains securely fixed at large angle of heel, an Administration may apply the following criteria in substitution for criteria given in 5.1 above:

- (a) The area under the righting lever (GZ curve) should not be less than 0.08 metre-radians up to  $\theta = 40^\circ$  or the angle of flooding if this angle is less than  $40^\circ$ .

\*  $\theta_f$  is an angle of heel at which openings in the hull, superstructures or deckhouses which cannot be closed weathertight immerse. In applying this criterion, small openings through which progressive flooding cannot take place need not be considered as open.

\*\* Where there is no limiting superstructure at the after end, the timber deck cargo shall extend at least to the after end of the aftermost hatchway.



- (b) The maximum value of the righting lever (GZ) should be at least 0.25 m.
- (c) At all times during a voyage the metacentric height  $GM_0$  should be positive after correction for the free surface effects of liquid in tanks and, where appropriate, the absorption of water by the deck cargo and/or ice accretion on the exposed surfaces. Additionally, in the departure condition the metacentric height should be not less than 0.10 m.

5.3 The following additional criteria are recommended for passenger ships:

- (a) The angle of heel on account of crowding of passengers to one side as defined in Appendix II 2.(11) should not exceed  $10^\circ$ .
- (b) The angle of heel on account of turning should not exceed  $10^\circ$  when calculated using the following formula:

$$M_R = 0.02 \frac{V_0^2}{L} \Delta \left( KG - \frac{d}{2} \right)$$

Where:

$M_R$  = heeling moment in metre-tons.

$V_0$  = service speed in m/sec.

$L$  = Length of ship at waterline in m.

$\Delta$  = displacement in metric tons.

$d$  = mean draught in m.

$KG$  = height of centre of gravity above keel in m.

5.4 The criteria mentioned in 5.1, 5.2 and 5.3 fix minimum values, but no maximum values are recommended. It is advisable to avoid excessive values, since these might lead to acceleration forces which could be prejudicial to the ship, its complement, its equipment and to the safe carriage of the cargo.

5.5 Where anti-rolling devices are installed in a ship the Administration should be satisfied that the above criteria can be maintained when the devices are in operation.

5.6 A number of influences such as beam wind on ships with large windage area, icing of topsides, water trapped on deck, rolling characteristics, following seas, etc. adversely affect stability and the Administration is advised to take these into account so far as is deemed necessary.

5.7 Regard should be paid to the possible adverse effects on stability where certain bulk cargoes are carried. In this connexion attention should be paid to the Code of Safe Practice for Bulk Cargoes. Ships carrying grain in bulk should comply with the criteria mentioned in 5.1 in addition to the stability requirements in Chapter VI of the International Convention for the Safety of Life at Sea, 1960.

## 6. INCLINING TEST

6.1 When construction is finished, each ship should undergo an inclining test, actual displacement and co-ordinates of the centre of gravity being determined for the light ship condition.

6.2 The Administration may allow the inclining test of an individual ship to be dispensed with, provided basic stability data are available from the inclining test of a sister ship.

## 7. STABILITY INFORMATION

7.1 The master of any ship to which the present Recommendation applies should receive information which will enable him to assess with ease and certainty the stability of his ship in different service conditions. A duplicate of this information should be communicated to the Administration.

7.2 Stability information should comprise:

- (i) Stability characteristics of typical loading conditions;
- (ii) Information in the form of tables or diagrams which will enable the master to assess the stability of his ship and verify whether it is sufficient in all loading conditions differing from the standard ones. This information should include, in particular, a curve or table giving, as a function of the draughts, the required initial metacentric height  $GM_0$  (or any other stability parameter) which ensures that the stability is in compliance with the criteria given in 5.1 above;

- (iii) Information on the proper use of anti-rolling devices if these are installed in the ship;
- (iv) Additionally, information enabling the ship's master to determine the initial metacentric height  $GM_0$  by means of rolling test as described in the Annex to the Memorandum to Administrations reproduced at Appendix III would be desirable;
- (v) Notes on the corrections to be made to the initial metacentric height  $GM_0$  to take account of free surface liquids.
- (vi) For ships carrying timber deck cargoes the Administration may deem it necessary that the master be given information setting out the changes in deck cargo from that shown in the loading conditions, when the permeability of the deck cargo is significantly different from 25 per cent.
- (vii) For ships carrying timber deck cargoes conditions should be shown indicating the maximum permissible amount of deck cargo having regard to the lightest stowage rate likely to be met in service.

#### APPENDIX I

### CALCULATION OF STABILITY CURVES

#### 1. General

(1) Hydrostatic and stability curves should normally be prepared on a designed trim basis. However, where the operating trim or the form and arrangement of the ship are such that change in trim has an appreciable effect on righting arms, such change in trim should be taken into account.

(2) The calculations should take into account the volume to the upper surface of the deck sheathing. In the case of wood ships the dimensions should be taken to the outside of the hull planking.

#### Superstructures, Deckhouses, etc. which may be taken into account

(3) Enclosed superstructures complying with Regulation 3(10)(b) of the 1966 Load Line Convention may be taken into account.

(4) The second tier of similarly enclosed superstructures may also be taken into account.

(5) Deckhouses on the freeboard deck may be taken into account, provided that they comply with the conditions for enclosed superstructures laid down in Regulation 3(10)(b) of the 1966 Load Line Convention.

(6) Where deckhouses comply with the above conditions, except that no additional exit is provided to a deck above, such deckhouses should not be taken into account; however, any deck openings inside such deckhouses shall be considered as closed even where no means of closure are provided.

(7) Deckhouses, the doors of which do not comply with the requirements of Regulation 12 of the 1966 Load Line Convention should not be taken into account; however, any deck openings inside the deckhouse are regarded as closed where their means of closure comply with the requirements of Regulations 15, 17 or 18 of the 1966 Load Line Convention.

(8) Deckhouses on decks above the freeboard deck should not be taken into account, but openings within them may be regarded as closed.

(9) Superstructures and deckhouses not regarded as enclosed can, however, be taken into account in stability calculations up to the angle at which their openings are flooded. (At this angle, the statical stability curve should show one or more steps, and in subsequent computations the flooded space should be considered non-existent.)

(10) In cases where the ship would sink due to flooding through any openings, the stability curve should be cut short at the corresponding angle of flooding and the ship should be considered to have entirely lost her stability.

(11) Small openings such as those for passing wires or chains, tackle and anchors, and also holes of scuppers, discharge and sanitary pipes should not be considered as open if they submerge at an angle of inclination more than  $30^\circ$ . If they submerge at an angle of  $30^\circ$  or less, these openings should be assumed open if the Administration considers this to be a source of significant flooding.

(12) Trunks may be taken into account. Hatchways may also be taken into account having regard to the effectiveness of their closures.

### 3. Effect of Liquid in Tanks

(13) For all conditions, the initial metacentric height and the stability curves should be corrected for the effect of free surfaces of liquids in tanks in accordance with the following assumptions:

- (i) Tanks which are taken into consideration when determining the effect of liquids on the stability at all angles of inclination should include single tanks or combinations of tanks for each kind of liquid (including those for water ballast) which according to the service conditions can simultaneously have free surfaces.
- (ii) For the purpose of determining this free surface correction, the tanks assumed slack should be those which develop the greatest free surface moment,  $M_{f.s.}$  at a  $30^\circ$  inclination, when in the 50 per cent full condition.
- (iii) The value of  $M_{f.s.}$  for each tank may be derived from the formula:

$$M_{f.s.} = v\gamma k\sqrt{\delta}$$

Where:

$M_{f.s.}$  = the free surface moment at any inclination in metre-tons,

$v$  = the tank total capacity in  $m^3$ ,

$b$  = the tank maximum breadth in m,

$\gamma$  = the specific weight of liquid in the tank in  $t/m^3$ ,

$\delta = \frac{v}{b^3h}$  = the tank block coefficient,

$h$  = the tank maximum height in m,

$l$  = the tank maximum length in m,

$k$  = dimensionless coefficient to be determined from the following table according to the ratio  $b/h$ . The intermediate values are determined by interpolation (linear or graphic).

- (iv) Small tanks, which satisfy the following condition using the value of  $k$  corresponding to the angle of inclination of  $30^\circ$ , need not be included in computation:

$$v\gamma k\sqrt{\delta} < 0.01\Delta_{min}$$

Where:

$\Delta_{min}$  = minimum ship displacement in tons (metric tons).

- (v) The usual remainder of liquids in the empty tanks is not taken into account in computation.

### 4. Effect of Timber Deck Cargo

(14) In the case of ships carrying timber deck cargoes the Administration may allow account to be taken of the buoyancy of the deck cargo assuming that such cargo has a permeability of 25 per cent of the volume occupied by the cargo. Additional curves of stability may be required if the Administration considers it necessary to investigate the influence of different permeabilities and/or assumed effective height of the deck cargo.

TABLE OF VALUES FOR COEFFICIENT "K" FOR CALCULATING  
FREE SURFACE CORRECTIONS

$K = \frac{\sin^2 \theta}{12} \frac{(1 + \tan^2 \theta) \times b/h}{\cos \theta} \frac{(1 + \tan \theta)}{b/h} \frac{\cos \theta}{(2b/h)^2} \frac{(1 + \cot^2 \theta)}{b/h}$														
where $\cot \theta \geq b/h$														
where $\cot \theta \leq b/h$														
$\theta$ $b/h$	5°	10°	15°	20°	30°	40°	45°	50°	60°	70°	75°	80°	90°	0 $b/h$
20	0.11	0.12	0.12	0.12	0.11	0.10	0.09	0.09	0.07	0.05	0.04	0.03	0.01	20
10	0.07	0.11	0.12	0.12	0.11	0.10	0.10	0.09	0.07	0.05	0.04	0.03	0.01	10
5	0.04	0.07	0.10	0.11	0.11	0.11	0.10	0.10	0.08	0.07	0.06	0.05	0.03	5
3	0.02	0.04	0.07	0.09	0.11	0.11	0.11	0.10	0.09	0.08	0.07	0.06	0.04	3
2	0.01	0.03	0.04	0.06	0.09	0.11	0.11	0.11	0.10	0.09	0.09	0.08	0.06	2
1.5	0.01	0.02	0.03	0.05	0.07	0.10	0.11	0.11	0.11	0.11	0.10	0.10	0.08	1.5
1	0.01	0.01	0.02	0.03	0.05	0.07	0.09	0.10	0.12	0.13	0.13	0.13	0.13	1
0.75	0.01	0.01	0.02	0.02	0.04	0.05	0.07	0.08	0.12	0.15	0.16	0.16	0.17	0.75
0.5	0.00	0.01	0.01	0.02	0.02	0.04	0.04	0.05	0.09	0.16	0.18	0.21	0.25	0.5
0.3	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.03	0.05	0.11	0.19	0.29	0.42	0.3
0.2	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.04	0.07	0.13	0.27	0.63	0.2
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.06	0.14	1.25	0.1

## APPENDIX II

## STANDARD CONDITIONS OF LOADING TO BE EXAMINED

## 1. Loading Conditions

The standard loading conditions referred to in 4.2 of the Recommendation are as follows:

(1) *Passenger ship*

- (i) ship in the fully loaded departure condition with full stores and fuel and with the full number of passengers with their luggage;
- (ii) ship in the fully loaded arrival condition, with the full number of passengers and their luggage but with only 10 per cent stores and fuel remaining;
- (iii) ship without cargo, but with full stores and fuel and the full number of passengers and their luggage;
- (iv) ship in the same condition as at (iii) above but with only 10 per cent stores and fuel remaining.

(2) *Cargo ship*

- (i) ship in the fully loaded departure condition, with cargo homogeneously distributed throughout all cargo spaces and with full stores and fuel;
- (ii) ship in the fully loaded arrival condition with cargo homogeneously distributed throughout all cargo spaces and with 10 per cent stores and fuel remaining;
- (iii) ship in ballast in the departure condition, without cargo but with full stores and fuel;
- (iv) ship in ballast in the arrival condition, without cargo and with 10 per cent stores and fuel remaining.

(3) *Cargo ships intended to carry deck cargoes*

- (i) ship in the fully loaded departure condition with cargo homogeneously distributed in the holds and with cargo specified in extension and weight on deck, with full stores and fuel;
- (ii) ship in the fully loaded arrival condition with cargo homogeneously distributed in holds and with a cargo specified in extension and weight on deck, with 10 per cent stores and fuel.

## 2. Assumptions for Calculating Loading Conditions

- (1) For fully loaded conditions mentioned in 1.(2)(i), (2)(ii), (3)(i) and (3)(ii) of this Appendix if a dry cargo ship has tanks for liquid cargo, the effective deadweight in the loading conditions therein described should be distributed according to two assumptions, i.e. (i) cargo tanks full, and (ii) cargo tanks empty
- (2) In conditions mentioned in 1.(1)(i) and (2)(i) of this Appendix, it should be assumed that the ship is loaded to her subdivision loadline or summer loadline or if intended to carry a timber deck cargo, to the summer timber loadline with water ballast tanks empty.
- (3) If in any loading condition water ballast is necessary, additional diagrams should be calculated taking into account the water ballast. Its quantity and disposition should be stated.
- (4) In all cases the cargo in holds is assumed to be fully homogeneous unless this condition is inconsistent with the practical service of the ship.
- (5) In all cases when deck cargo is carried a realistic stowage weight should be assumed and stated, including the height of the cargo.
- (6) Where timber deck cargoes are carried, the amount of cargo and ballast should correspond to the worst service condition in which all the relevant stability criteria in 5 are met. In the arrival condition it should be assumed that the weight of the deck cargo has increased by 10 per cent due to water absorption.
- (7) When timber deck cargoes are carried and it is anticipated that some formation of ice will take place an allowance should be made in the arrival condition for the additional weight.

- (8) A weight of 75 kg should be assumed for each passenger except that this value may be reduced to not less than 60 kg where this can be justified. In addition the weight and distribution of the luggage should be determined by the Administration.
- (9) The height of the centre of gravity for passengers should be assumed equal to:
- (i) 1.0 metre above deck level for passengers standing upright. Account may be taken, if necessary, of camber and sheer of deck;
  - (ii) 0.30 metre above the seat in respect of seated passengers.
- (10) Passengers and luggage should be considered to be in the spaces normally at their disposal, when assessing compliance with the criteria at 5.1(a), (b), (c) and (d) of the Recommendation.
- (11) Passengers without luggage should be considered as distributed to produce the most unfavourable combination of passenger heeling moment and/or initial metacentric height, which may be obtained in practice, when assessing compliance with the criteria at 5.3(a) and (b) of the Recommendation respectively. In this connexion it is anticipated that a value higher than 4 persons per square metre will not be necessary.

### APPENDIX III

#### MEMORANDUM TO ADMINISTRATIONS ON AN APPROXIMATE DETERMINATION OF SHIP'S STABILITY BY MEANS OF THE ROLLING PERIOD TESTS (for ships up to 70 m in length)

1. Recognizing the desirability of supplying to masters of small ships instructions for a simplified determination of initial stability, attention was given to the rolling period tests. Studies on this matter have now been completed with the result that the rolling period test may be recommended as a useful means of approximately determining the initial stability of small ships when it is not practicable to give approved loading conditions or other stability information, or as a supplement to such information.
2. Investigations comprising the evaluation of a number of inclining and rolling tests according to various formulae showed that the following formula gave the best results and it has the advantage of being the simplest

$$GM_{\text{L}} = \left( \frac{fB}{T_r} \right)^2.$$

Where:

- $f$  = factor for the rolling period/rolling coefficient (different for feet and metric systems),
  - $B$  = breadth of the ship in feet or metric units.
  - $T_r$  = time for a full rolling period in seconds (i.e. for one oscillation "to and fro" port - starboard - port, or vice versa)
3. The factor "f" is of the greatest importance and the data from the above tests were used for assessing the influence of the distribution of the various masses in the whole body of the loaded ship.
  4. For coasters of normal size (excluding tankers), the following average values were observed:

	metric system	feet system
(a) Empty ship or ship carrying ballast	$f \sim 0.88$	$f \sim 0.49$
(b) Ship fully loaded and with liquids in tanks comprising the following percentage of the total load on board (i.e. cargo, liquids, stores, etc.)		
1. 20 per cent of total load	$f \sim 0.78$	$f \sim 0.435$
2. 10 per cent of total load	$f \sim 0.75$	$f \sim 0.415$
3. 5 per cent of total load	$f \sim 0.73$	$f \sim 0.405$

The stated values are mean values. Generally, observed f-values were within  $\pm 0.05$  of those given above.

5. These f-values were based upon a series of limited tests and, therefore, Administrations should re-examine these in the light of any different circumstances applying to their own ships.

6. It must be noted that the greater the distance of masses from the rolling axis, the greater the rolling coefficient will be.

Therefore it can be expected that:

The rolling coefficient for an unloaded ship, i.e. for a hollow body, will be higher than that for a loaded ship.

The rolling coefficient for a ship carrying a great amount of bunkers and ballast – both groups are usually located in the double bottom, i.e. far away from the rolling axis – will be higher than that of the same ship having an empty double bottom.

7. The above recommended rolling coefficients were determined by tests with vessels in port and with their consumable liquids at normal working levels; thus, the influences exerted by the vicinity of the quay, the limited depth of water and the free surfaces of liquids in service tanks are covered.

8. Experiments have shown that the results of the rolling test method get increasingly less reliable the nearer they approach GM-values of 0.20 m and below.

9. For the following reasons, it is not generally recommended that results be obtained from rolling oscillations taken in a seaway:

- (a) Exact coefficients for tests in open waters are not available.
- (b) The rolling periods observed may not be free oscillations but forced oscillations due to seaway.
- (c) Frequently, oscillations are either irregular or only regular for too short an interval of time to allow accurate measurements to be observed.
- (d) Specialized recording equipment is necessary.

10. However, sometimes it may be desirable to use the vessel's period of roll as a means of approximately judging the stability at sea. If this is done, care should be taken to discard readings which depart appreciably from the majority of other observations. Forced oscillations corresponding to the sea period and differing from the natural period at which the vessel seems to move should be disregarded. In order to obtain satisfactory results, it may be necessary to select intervals when the sea action is least violent, and it may be necessary to discard a considerable number of observations.

11. In view of the foregoing circumstances, it needs to be recognized that the determination of the stability by means of the rolling test in disturbed waters should only be regarded as a very approximate estimation.

12. The formula given in paragraph 2 above can be reduced to:

$$GM_o = \frac{F}{T_r^2}$$

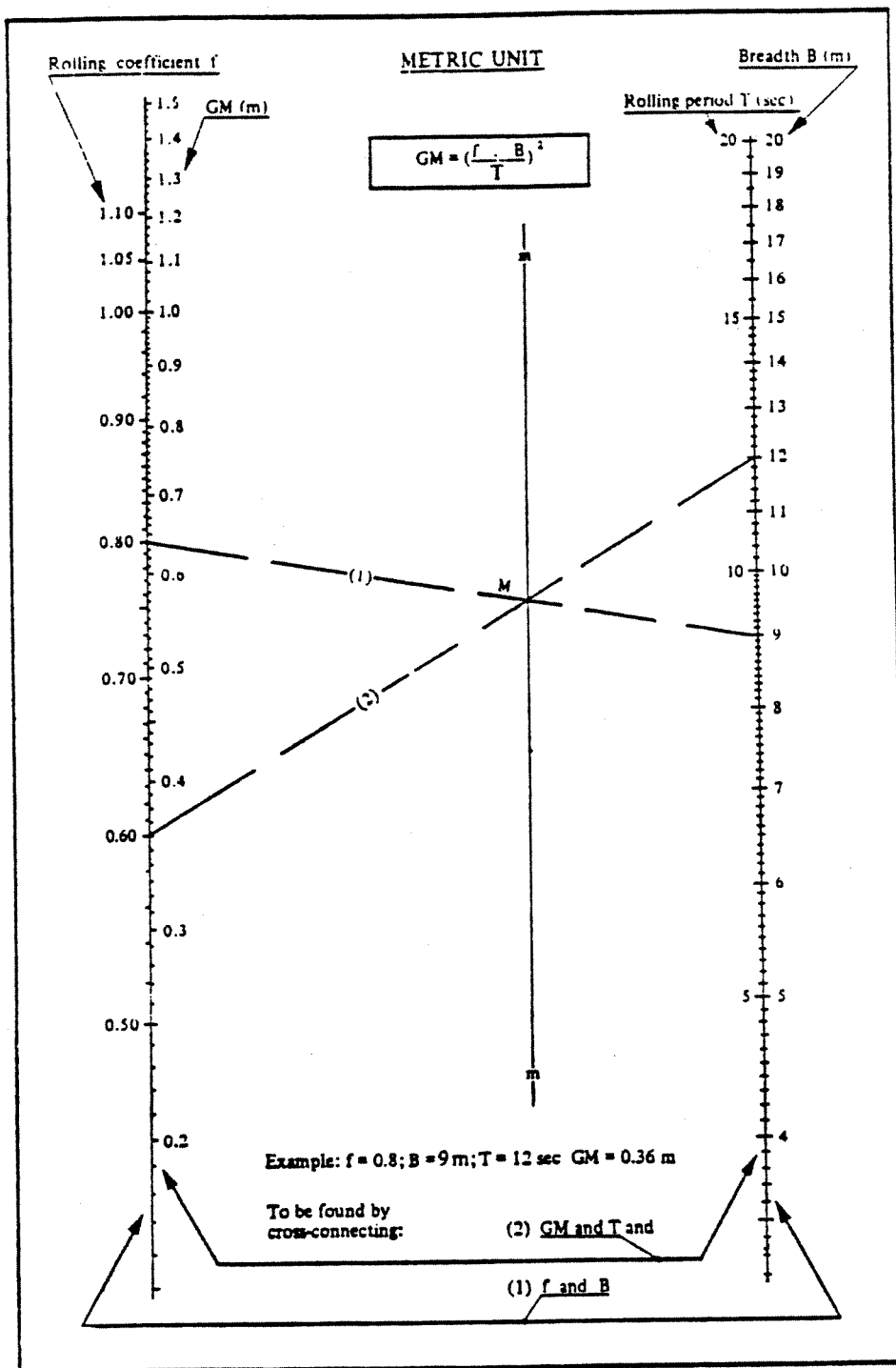
and the Administration should determine the F-value(s) for each vessel.

13. The determination of the stability can be simplified by giving the master permissible rolling periods, in relation to the draughts, for the appropriate value(s) of F considered necessary.

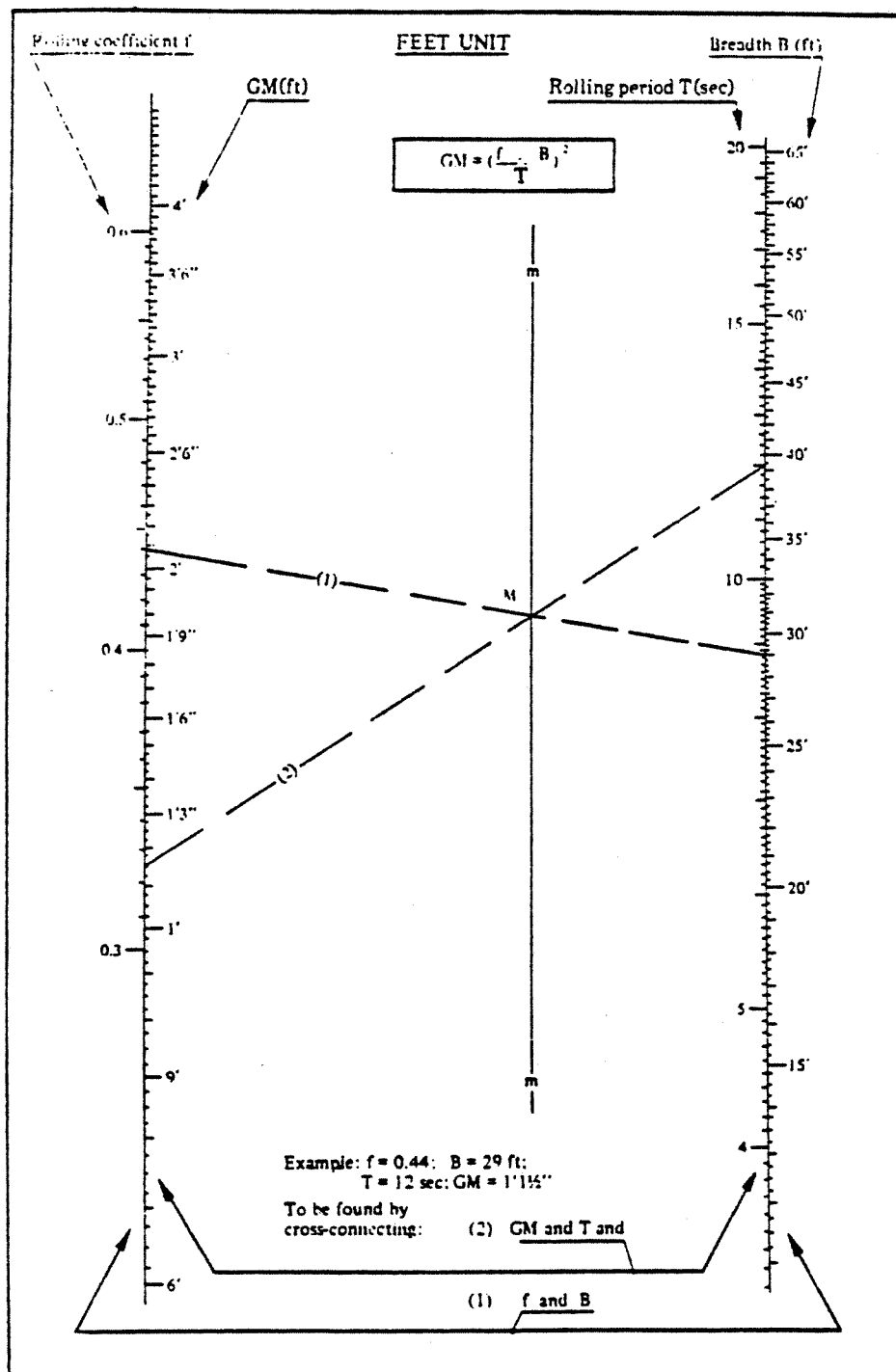
14. The initial stability may also be more easily determined graphically by using one of the attached sample nomograms for feet and/or metric units as described below:

- (a) The values for B and f are marked in the relevant scales and connected by a straight line (1). This straight line intersects the vertical line (mm) in the point (M).
- (b) A second straight line (2) which connects this point (M) and the point on the  $T_r$  scale corresponding with the determined rolling period, intersects the GM scale at the requested value.

15. The Annex to Appendix III shows an example of a recommended form in which these instructions might be presented by each Administration to the masters. It is considered that each Administration should recommend the F-value or values to be used.







ANNEX TO APPENDIX III

**SUGGESTED FORM OF GUIDANCE TO THE MASTER ON AN  
APPROXIMATE DETERMINATION OF SHIP'S STABILITY  
BY MEANS OF THE ROLLING PERIOD TEST**

**Introduction**

1. If the following instructions are properly carried out, this method allows a reasonably quick and accurate estimation of the metacentric height, which is a measure of the ship's stability.
2. The method depends upon the relationship between the metacentric height and the rolling period in terms of the extreme breadth of the vessel.

**Test Procedure**

3. The rolling period required is the time for one complete oscillation of the vessel and to ensure the most accurate results in obtaining this value the following precautions should be observed:
  - (a) The test should be conducted with the vessel in harbour, in smooth water with the minimum interference from wind and tide.
  - (b) Starting with the vessel at the extreme end of a roll to one side (say port) and the vessel about to move towards the upright, *one complete oscillation* will have been made when the vessel has moved right across to the other extreme side (i.e. starboard) and returned to the original starting point and is about to commence the next roll.
  - (c) By means of a stop-watch, the time should be taken for not less than about 5 of these complete oscillations; the counting of these oscillations should begin when the vessel is at the extreme end of a roll. After allowing the roll to completely fade away, this operation should be repeated at least twice more. If possible, in every case the same number of complete oscillations should be timed to establish that the readings are consistent, i.e. repeating themselves within reasonable limits. Knowing the total time for the total number of oscillations made, the mean time for one complete oscillation can be calculated.
  - (d) The vessel can be made to roll by rhythmically lifting up and putting down a weight as far off middle-line as possible; by pulling on the mast with a rope; by people running athwartships in unison; or by any other means. However, and this is most important, as soon as this forced rolling has commenced the means by which it has been induced must be stopped and the vessel allowed to roll freely and naturally. If rolling has been induced by lowering or raising a weight it is preferable that the weight is moved by a dockside crane. If the ship's own derrick is used, the weight should be placed on the deck, at the middle-line, as soon as the rolling is established.
  - (e) The timing and counting of the oscillations should only begin when it is judged that the vessel is rolling freely and naturally, and only as much as is necessary to accurately count these oscillations.
  - (f) The mooring should be slack and the vessel "breasted off" to avoid making any contact during its rolling. To check this, and also to get some idea of the number of complete oscillations that can be reasonably counted and timed, a preliminary rolling test should be made before starting to record actual times.
  - (g) Care should be taken to ensure that there is a reasonable clearance of water under the keel and at the sides of the vessel.
  - (h) Weights of reasonable size which are liable to swing, (e.g. a life-boat), or liable to move (e.g. a drum), should be secured against such movement. The free surface effects of slack tanks should be kept as small as is practicable during the test and the voyage.

**Determination of the Initial Stability**

4. Having calculated the period for one complete oscillation, say T seconds, the metacentric height  $GM_0$  can be calculated from the following formula:

$$GM_0 = \frac{F}{T^2}$$

where F is ... [to be determined for each particular vessel by the Administration].

5. The calculated value of  $GM_0$  should be equal to or greater than the critical value which is . . . [to be determined for each particular vessel by the Administration].

#### Limitations to the Use of this Method

6. A long period of roll corresponding to a  $GM_0$  of 0.20 m or below, indicates a condition of low stability. However, under such circumstances, accuracy in determination of the actual value of  $GM_0$  is reduced.
7. If, for some reason, these rolling tests are carried out in open, deep but smooth waters, inducing the roll, for example, by putting over the helm, then the  $GM_0$  calculated by using the method and coefficient of paragraph 3 above should be reduced by [figure to be estimated by the Administration] to obtain the final answer.
8. The determination of stability by means of the rolling test in disturbed waters should only be regarded as a very approximate estimation. If such test is performed, care should be taken to discard readings which depart appreciably from the majority of other observations. Forced oscillations corresponding to the sea period and differing from the natural period at which the vessel seems to move should be disregarded. In order to obtain satisfactory results, it may be necessary to select intervals when the sea action is least violent, and it may be necessary to discard a considerable number of observations.

### ANNEX C

#### SUGGESTED PRACTICES TO MEET THE PROVISIONS OF THE CODE OF SAFE PRACTICE FOR SHIPS CARRYING TIMBER DECK CARGOES

The primary requirements for the safe carriage of any timber deck cargo is a solid, compact stowage during all stages of the deck loading. This can only be achieved by constant supervision by ship's personnel during loading and insistence that the cargo be compacted and stowed rather than stacked. Such stacking can occur with packaged timber particularly when loaded in units of 4 to 6 packages per lift. This is a frequent cause of shifts of cargo, listing, failure of lashings with consequent loss of cargo and has sometimes resulted in damage to the ship itself when the latter has been driven incautiously during heavy weather.

#### 1. THE STOWAGE OF PACKAGED TIMBER

- 1.1 Packages which contain such random lengths as would disrupt the compaction of the stow should not be loaded on deck. Other packages of random lengths capable of compact stowage may be loaded on deck but not on exposed surfaces or in the stowage outboard of the hatch coamings.
- 1.2 Packages for deck stowage should have strong bands to prevent slackening and disintegration of the package during the voyage which would cause a loosening of the stow. Slack bands on the top surface of a deck cargo are dangerous foot traps.
- 1.3 Before commencing to load on the deck or hatches a firm and level stowage surface should be prepared by laying dunnage of rough lumber. Such dunnage should be placed in the direction which will spread the load across the ship's underdeck structure.
- 1.4 Throughout the loading a level and firm stowage surface should be prepared on each working tier by the use of rough dunnage of such lengths as to spread over at least three adjacent packages to produce a binding effect within the stow particularly in the wings. Any gaps occurring around packages such as in the vicinity of hatch coamings and deck obstructions in which the cargo may work at sea should be filled with loose timber or efficiently chocked off. For this purpose a supply of timber chocking material should be available to the ship.
- 1.5 Packages at the outboard edges of the stow should be positioned so that they do not extend over the eyepads and obstruct the vertical lead of the athwartship lashings.
- 1.6 Large heavy boards and squares of timber when loaded on deck in combination with packages should preferably be stowed separately. When placed in upper tiers heavy pieces of timber have tended to work at sea and cause some breaking of packages. In the event that boards and squares are stowed on top of packages they should be efficiently restrained from movement.

1.7 Due to the system of athwartship lashing the stowage of packages should generally be in the fore and aft direction. This is not always possible and some athwartship stowage cannot be avoided due to the necessity of blocking out where the stow is broken by deck structures. Excluding the wings of the two topmost tiers and the outboard packages of the stow, it is advisable to have one or more non-adjacent tiers stowed athwartship when above the level of the hatches to produce a binding effect within the cargo. When practical it is recommended that at least two athwartship lashings secure each package at the side vertical faces of the stow. If necessary, when a tier has been stowed athwartship, the outboard edge of the tier may be secured by laying a line of packages in the fore and aft direction.

1.8 Rounded angle pieces of suitable material should be used along the top outboard edge of the stow to bear the stress and permit free roving of the athwartship lashing thus ensuring efficient tightening and securing of the deck cargo. For increased efficiency such angle pieces should have a leg length of at least one foot.

## 2. THE SECURING OF HEAVY LOGS ADDITIONAL TO THAT GIVEN IN THIS CODE

2.1 When a cargo of logs has been stowed to a height of one tier of logs over the hatches, a system of athwartship lashings of wire rope to the specifications of Section 4 of this Code should be set up in short lengths over the entire length of the cargo such that:

- (a) lashings should be secured at an upright and then rove between two or more port and starboard pairs of uprights, at the same height as the cargo to cover the length of the cargo;
- (b) when overstowed the lashings shall be given sufficient slack to enable the logs to tension the wire without disturbing the compaction but to produce an inboard binding effect on the uprights; and
- (c) when the height of the deck stow or the size of logs are such that additional lashings as described in this section are considered necessary, they should be set up identically at appropriate levels of the cargo.

2.2 The use of a continuous wire rope lashing, as described below, has been found extremely effective in preventing movement and loss in deck cargoes of heavy logs. To compact the deck stow and facilitate tightening of the chain lashings, additional overall lashings of wire rope may be used such that:

- (a) these lashings are shackled at eye plates in the sheer strake, deck stringer plate or other strengthened point at positions midway between the uprights;
- (b) they consist primarily of bights of wire connecting adjacent securing positions in a fore and aft direction, each bight to be of sufficient length to stretch over the top surface of the final stow to an inboard distance of approximately one third of the immediate breadth of the cargo; or
- (c) as an alternative to bights, single independent wire pendants with eye-splices may be shackled at eye plates in the sheer strake or deck stringer plate or other strengthened point at positions close to the uprights throughout the extent of the deck cargo, each pendant being of sufficient length to extend across the top surface of the cargo to a distance inboard of about one third of the immediate breadth.

2.3 A snatch block or roller shackle is attached at the inboard part of each bight or pendant through which is rove a continuous wire rope which passes from side to side across the top of the cargo to lace together all such snatch blocks or roller shackles in an athwartship direction along the entire length of each section of deck cargo. One or both ends of the lacing wire should be brought to a winch or winches and, after tightening to facilitate further tensioning of the main athwartship lashings, made fast.

## 3. THE STOWAGE OF PULP WOOD AND PITPROPS

When stowed in the manner here described good compaction of the deck cargo can be obtained.

- 3.1 (a) In the deck area clear of the line of hatches, the logs should be stowed in the athwartship direction, canted inboard by some logs laid fore and aft in the scuppers;
- (b) at the centre of the stow, along the line of hatches, the logs are laid in the fore and aft direction when the wing cargo has reached hatch height; and
- (c) at the completion of loading, the cargo should have a level surface with a slight crown towards the centre.

3.2 To prevent logs being washed out from below their lashings it is recommended that nets or tarpaulins may be used as follows:

- (a) the ends of each continuous section of deck cargo, if not stowed flush with a superstructure bulkhead, may be fitted with a net or tarpaulin stretched and secured over the athwartship vertical surface:
  - (b) over the fore end of each continuous section of deck cargo, and in the waist of the ship, the top surface may be fitted with a net or tarpaulin stretched and secured across the breadth of the cargo and-brought down the outboard vertical sides to securings at deck level.
-